

IN THE CLAIMS:

The following is a complete listing of the claims in this application, reflects all changes currently being made to the claims, and replaces all earlier versions and all earlier listings of the claims:

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1. (Currently amended) A solid-state image pickup apparatus comprising:
- a photoelectric conversion unit;
  - a transfer ~~means~~ unit for transferring signal charges from said photoelectric conversion unit;
  - a capacitance ~~means~~ unit for holding the transferred signal charges;
  - and
  - an amplification ~~means~~ unit for outputting a signal corresponding to the signal charges held by said capacitance ~~means~~ unit,
- wherein said capacitance ~~means having a capacitance unit including~~ unit includes a first capacitance value and an additive capacitance unit for adding a capacitance to said capacitance unit to increase the first capacitance value to obtain a second capacitance value, and
- wherein a signal read-out from said amplification ~~means~~ unit has a first read-out mode in which a signal is read out while holding the signal charges in said capacitance unit and said additive capacitance unit, and a second read-out mode in which a signal is read out while holding the signal charges in said capacitance unit.

2. (Currently amended) An apparatus according to claim 1, further comprising at least one different additive capacitance unit for further adding a capacitance to said capacitance unit and said additive capacitance unit,

wherein read modes in which a signal is read out from said amplification ~~means~~ unit while holding the signal charges in said capacitance ~~means~~ unit in correspondence with each of capacitance values obtained by adding said different additive capacitance unit to each of said capacitance unit and said additive capacitance unit are prepared in number corresponding to the number of different additive capacitance units.

 3. (Currently amended) A solid-state image pickup apparatus

comprising:

a photoelectric conversion unit;

a capacitance ~~means~~ unit for holding signal charges transferred from said photoelectric conversion unit;

a transfer field effect transistor for transferring the signal charges from said photoelectric conversion unit and adding a capacitance formed by a channel to said capacitance ~~means~~ unit to increase a capacitance value; and

an amplification ~~means~~ unit for outputting a signal corresponding to the signal charges held by said capacitance ~~means~~ unit or the signal charges held by said capacitance ~~means~~ unit and the capacitance of said transfer field effect transistor,

wherein a signal read-out from said amplification ~~means~~ unit has a first read-out mode in which a signal is read out while holding the signal charges in said

capacitance ~~means~~ unit and the capacitance of said transfer field effect transistor, and a second read-out mode in which a signal is read out while holding the signal charges in said capacitance ~~means~~ unit.

4. (Currently Amended) A solid-state image pickup apparatus comprising:

a photoelectric conversion unit;

a first and a second transfer ~~means~~ unit for transferring signal

charges from said photoelectric conversion unit;

a first capacitance ~~means~~ unit, inserted between said first transfer ~~means~~ unit and said second transfer ~~means~~ unit for holding the transferred signal charges;

a second capacitance ~~means~~ unit, arranged on an output side of said second transfer ~~means~~ unit, for holding the transferred signal charges; and

an amplification ~~means~~ unit for outputting a signal corresponding to the signal charges held by said first and second capacitance ~~means~~ unit or the signal charges held by said second capacitance ~~means~~ unit,

wherein a signal read-out from said amplification ~~means~~ unit has a first read-out mode in which a signal is read out while holding the signal charges in said first and second capacitance ~~means~~ units, and a second read-out mode in which a signal is read out while holding the signal charges in said second capacitance ~~means~~ unit.

5. (Currently amended) An apparatus according to claim 1, further comprising ~~means for adding output~~ an adding unit for outputting signals in the respective read-out modes.

6. (Currently amended) An apparatus according to claim 3, further comprising ~~means for adding output~~ an adding unit for outputting signals in the respective read-out modes.

7. (Currently amended) An apparatus according to claim 4, further comprising ~~means for adding output~~ an adding unit for outputting signals in the respective read-out modes.

8. (Currently amended) A solid-state image pickup apparatus comprising:

a photoelectric conversion unit;

a transfer ~~means~~ unit for transferring signal charges from said photoelectric conversion unit;

a capacitance ~~means~~ unit for holding the transferred signal charges;

and

an amplification ~~means~~ unit for outputting a first signal without holding any signal charges in said capacitance ~~means~~ unit and outputting a second signal

corresponding to the signal charges while keeping the signal charges held by said capacitance ~~means~~ unit,

wherein said capacitance ~~means including a capacitance unit having~~ unit includes a first capacitance value and an additive capacitance unit for adding a capacitance to said capacitance unit to increase the first capacitance value to obtain a second capacitance value, and

wherein a first signal read-out from said amplification ~~means~~ unit has a first non-holding read-out mode in which a signal is read out from said capacitance unit without holding any signal charges, and a second non-holding read-out mode in which a signal is read out from said capacitance unit and said additive capacitance unit without holding any signal charges, and


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a second signal read-out from said amplification ~~means~~ unit has a first holding read-out mode in which a signal is read out while keeping the signal charges held by said capacitance unit, and a second holding read-out mode in which a signal is read out while keeping the signal charges held by said capacitance unit and said additive capacitance unit.

9. (Currently amended) An apparatus according to claim 8, ~~wherein~~ further comprising at least one different additive capacitance unit for further adding a capacitance to said capacitance unit and said additive capacitance unit,

wherein non-holding read-out modes in which a signal is read out from said amplification ~~means~~ unit without holding any signal charges in said capacitance

~~means capacitance unit~~ in correspondence with each of capacitance values obtained by adding said different additive capacitance unit to each of said capacitance unit and said additive capacitance unit, and holding read-out modes in which a signal is read out from said amplification ~~means unit~~ while keeping the signal charges held by said ~~capacitance means capacitance unit~~ in correspondence with each of capacitance values obtained by adding said different additive capacitance unit to each of said capacitance unit and said additive capacitance unit are prepared in number corresponding to the number of different additive capacitance units.

10. (Currently amended) A solid-state image pickup apparatus

 comprising:

a photoelectric conversion unit;

a capacitance ~~means unit~~ for holding signal charges transferred from said photoelectric conversion unit;


a transfer field effect transistor for transferring the signal charges from said photoelectric conversion unit and adding a capacitance formed by a channel to said capacitance unit to increase a capacitance value; and

~~amplification means~~ an amplification unit for outputting a first signal without holding any signal charges in said capacitance ~~means unit~~ and outputting a second signal corresponding to the signal charges held by said capacitance ~~means unit~~ or the signal charges held by said capacitance ~~means unit~~ and the capacitance of said transfer field effect transistor,

wherein a first signal read-out from said amplification ~~means~~ unit has a non-holding read-out mode in which a signal is read out from said capacitance ~~means~~ unit without holding any signal charges, and

a second signal read-out from said amplification ~~means~~ unit has a first holding read-out mode in which a signal is read out while keeping the signal charges held by said capacitance ~~means~~ unit and the capacitance of said transfer field effect transistor, and a second holding read-out mode in which a signal is read out while keeping the signal charges held by said capacitance ~~means~~ unit.

11. (Currently amended) A solid-state image pickup apparatus

 comprising:

a photoelectric conversion unit;

a first and a second transfer ~~means~~ unit for transferring signal charges from said photoelectric conversion unit;

a first capacitance ~~means~~ unit, inserted between said first transfer ~~means~~ unit and said second transfer ~~means~~ unit, for holding the transferred signal charges;

a second capacitance ~~means~~ unit, arranged on an output side of said second transfer ~~means~~ unit, for holding the transferred signal charges; and

an amplification ~~means~~ unit for outputting a first signal without holding any signal charges in said first and second capacitance ~~means~~ units or said second capacitance ~~means~~ unit and outputting a second signal corresponding to the signal charges

held by said first and second capacitance means units or said second capacitance means unit,

wherein a first signal read-out from said amplification means unit has a first non-holding read-out mode in which a signal is read out from said first and second capacitance means units without holding any signal charges, and a second non-holding read-out mode in which a signal is read out from said second capacitance means unit without holding any signal charges, and

a second signal read-out from said amplification means unit has a first holding read-out mode in which a signal is read out while keeping the signal charges held by said first and second capacitance means units, and a second holding read-out mode in which a signal is read out while keeping the signal charges held by said second capacitance means unit.

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12. (Currently amended) An apparatus according to claim 8, further comprising a first addition means unit for adding output signals in the respective non-holding read-out modes, a second addition means unit for adding output signals in the respective holding read-out modes, and a subtraction means unit for subtracting an output from said first addition means unit from an output from said second addition means unit.

13. (Currently amended) An apparatus according to claim 10, further comprising a first addition means unit for adding output signals in the respective non-holding read-out modes, a second addition means unit for adding output signals in the



respective holding read-out modes, and a subtraction means unit for subtracting an output from said first addition means unit from an output from said second addition means unit.

14. (Currently amended) An apparatus according to claim 11, further comprising a first addition means unit for adding output signals in the respective non-holding read-out modes, a second addition means unit for adding output signals in the respective holding read-out modes, and a subtraction means unit for subtracting an output from said first addition means unit from an output from said second addition means unit.

 15. (Currently amended) An apparatus according to claim 8, further comprising a subtraction means unit for subtracting an output signal in the read-out mode from an output signal in the holding read-out mode when the capacitance values are equal or substantially equal in correspondence with the number of capacitance values varying.

16. (Currently amended) An apparatus according to claim 10, further comprising a subtraction means unit for subtracting an output signal in the read-out mode from an output signal in the holding read-out mode when the capacitance values are equal or substantially equal in correspondence with the number of capacitance values varying.

17. (Currently amended) An apparatus according to claim 11, further comprising a subtraction means unit for subtracting an output signal in the read-out mode

from an output signal in the holding read-out mode when the capacitance values are equal or substantially equal in correspondence with the number of capacitance values varying.

18. (Original) An apparatus according to claim 1, wherein said additive capacitance unit or said additive capacitance unit and said different additive capacitance unit comprise variable capacitive elements electrically connected in parallel to said capacitance unit.

19. (Original) An apparatus according to claim 8, wherein said additive capacitance unit or said additive capacitance unit and said different additive capacitance unit comprise variable capacitive elements electrically connected in parallel to said capacitance unit.

20. (Original) An apparatus according to claim 8, wherein the order of the first non-holding read-out mode and the second non-holding read-out mode is the same as that of the first holding read-out mode and the second holding read-out mode.

21. (Original) An apparatus according to claim 11, wherein the order of the first non-holding read-out mode and the second non-holding read-out mode is the same as that of the first holding read-out mode and the second holding read-out mode.

22. (Original) A solid-state image pickup apparatus using, as an area sensor, said solid-state image pickup apparatus of any one of claims 1 to 21.

23. (Original) A solid-state image pickup apparatus using, as a line sensor, said solid-state image pickup apparatus of any one of claims 1 to 21.

24. (Canceled)

25. (Currently amended) ~~A method according to claim 24,~~ A signal read-out method for a solid-state image pickup apparatus which holds, in a capacitance unit, signal charges generated by a photoelectric conversion unit and outputs a signal corresponding to the signal charges held by the capacitance unit from an amplification unit, said method comprising:


a first read-out mode in which a signal is output from the amplification element while holding the signal charges generated by the photoelectric conversion unit in the capacitance unit set at a first capacitance value; and

a second read-out mode in which, after said first read-out mode, the capacitance value of the capacitance unit is changed from the first capacitance value to a second capacitance value, and a signal corresponding to the signal charges held by the capacitance unit set at the second capacitance value is output from the capacitance unit,  
further comprising

wherein at least one read-out mode in which, after the second read-out mode, the capacitance value of ~~said~~ the capacitance ~~means~~ unit is changed from the second capacitance value to an arbitrary capacitance value, and a signal corresponding to the signal charges held by ~~said~~ the capacitance ~~means~~ unit set at the arbitrary capacitance value is output from ~~said~~ the amplification ~~means~~ unit.

26. (Canceled)

27. (Currently amended) ~~A method according to claim 26, further~~

 comprising: A signal read-out method for a solid-state image pickup apparatus,

comprising:

a holding read-out mode in which a signal corresponding to signal charges generated by a photoelectric conversion unit is output from an amplification unit while keeping the signal charges held by a capacitance unit; and

a non-holding read-out mode in which a signal is output from the amplification unit without holding any signal charges in the capacitance unit,

wherein said holding read-out mode has a first holding read-out mode in which a signal is output from the amplification unit while keeping the signal charges held by the capacitance unit set at a first capacitance value, and a second holding read-out mode in which a signal is output from the amplification unit while keeping the signal charges held by the capacitance unit whose capacitance value is set at a second capacitance value different from the first capacitance value, and

wherein said non-holding read-out mode has a first non-holding read-out mode in which a signal is output from the amplification unit without holding any signal charges in the capacitance unit set at the first capacitance value, and a second non-holding read-out mode in which a signal is output from the amplification unit without holding any signal charges in the unit whose capacitance value is set at the second capacitance value different from the first capacitance value,

*And* wherein at least one holding read-out mode in which the capacitance value of ~~said~~ the capacitance ~~means~~ unit is changed from the second capacitance value to an arbitrary capacitance value, and a signal is output from ~~said~~ the amplification ~~means~~ unit while keeping the signal charges held by ~~said~~ the capacitance ~~means~~ unit set at the arbitrary capacitance value~~[[:]]~~, and

wherein at least one non-holding read-out mode in which the capacitance value of ~~said~~ the capacitance ~~means~~ unit is changed from the second capacitance value to an arbitrary capacitance value, and a signal is output from ~~said~~ the amplification ~~means~~ unit without holding any signal charges in ~~said~~ the capacitance ~~means~~ unit set at the arbitrary capacitance value.

28. and 29. (Canceled)

30. (Currently amended) ~~An apparatus according to claim 29, further comprising~~ A solid-state image pickup apparatus including a plurality of pixels, each pixel comprising:

a photoelectric conversion unit;  
a holding unit for holding a signal from said photoelectric  
conversion unit;  
a read-out unit for reading out the signal held by said holding unit;  
and  
a capacitance changing unit for changing a capacitance value of said  
holding unit; and  
a control means unit having a first mode in which a signal is read out  
from said read-out means unit while keeping said holding means unit set at a first  
capacitance value by said capacitance changing means unit, and a second mode in which a  
signal is read out from said read-out means unit while keeping said holding means unit set  
at a second capacitance value by said capacitance changing means unit.


31. (Currently amended) An apparatus according to claim 30, further  
comprising an addition means unit for adding the signal read out in the first mode and the  
signal read out in the second mode.

32. (Canceled)

33. (Currently amended) ~~An apparatus according to claim 32, A~~  
solid-state image pickup apparatus comprising:

a photoelectric conversion unit; and

a charge/voltage conversion unit for converting signal charges  
transferred from said photoelectric conversion unit into a signal voltage,  
wherein said charge/voltage conversion unit comprises a plurality of  
capacitances having different dependences on voltage, and  
wherein said charge/voltage conversion unit comprises an impurity  
diffusion region and a MOS structure unit, and the plurality of capacitances having  
different dependences on voltage comprise a capacitance formed in the impurity diffusion  
region and a capacitance formed in said MOS structure unit.



34. (Currently amended) An apparatus according to claim ~~[[32]]~~ 33,  
wherein said charge/voltage conversion unit comprises an impurity diffusion region and a  
buried semiconductor junction portion, and the plurality of capacitances having different  
dependences on voltage comprise a capacitance formed in the impurity diffusion region  
and a capacitance formed in said buried semiconductor junction portion.

35. (Currently amended) An apparatus according to claim 34, wherein  
the dependence of the capacitance formed in ~~said~~ the buried semiconductor junction  
portion on voltage is controlled by an impurity concentration or depth of a semiconductor  
region of one conductivity type of ~~said~~ the buried semiconductor junction portion.

36. (Currently amended) An apparatus according to claim 35, wherein  
the dependence of the capacitance formed in ~~said~~ the buried semiconductor junction

portion on voltage is controlled by a width of a semiconductor region of one conductivity type of ~~said~~ the buried semiconductor junction portion.

37. (Canceled)

38. ~~An apparatus according to claim 37, further comprising~~ A solid-state image pickup apparatus comprising:

a photoelectric conversion unit;

a charge/voltage conversion unit for converting signal charges

transferred from said photoelectric conversion unit into a signal voltage,

wherein said charge/voltage conversion unit comprises a plurality of capacitances having different dependences on voltage;

a reset unit for applying a reset voltage to reset said charge/voltage conversion unit,

wherein a charge/voltage conversion efficiency of said charge/voltage conversion unit is controlled by controlling a voltage value of the reset voltage; and

a sampling means unit for sampling a light amount incident on said photoelectric conversion unit, wherein the reset voltage is set in accordance with a sampling signal from said sampling means unit.



39. (Original) An apparatus according to claim 38, wherein the sampling signal is a signal one frame ahead.

40. (Original) An apparatus according to claim 38, wherein the sampling signal is one of an overflow drain signal and a smear signal.

41. (Original) An apparatus according to claim 38, wherein before an accumulation period of the signal charges, second signal charges accumulated in an accumulation period shorter than the accumulation period are transferred to the impurity diffusion region, and the second signal charges are used as the sampling signal.

42.-44. (Canceled)

45. (New) An image pickup apparatus comprising:  
a plurality of pixels, each of which includes a photoelectric conversion portion and an amplifying element which amplifies a photoelectric conversion signal from the photoelectric conversion portion;

a driving circuit which selectively outputs a first photoelectric conversion signal obtained with a first sensitivity and a second photoelectric conversion signal obtained with a second sensitivity from the amplifying element,

wherein the first photoelectric conversion signal of the first sensitivity and the second photoelectric conversion signal of the second sensitivity are based on photoelectric conversion performed at a same timing; and a signal processing circuit which forms a single image using the first and second photoelectric conversion signals.

46. (New) An image pickup apparatus according to Claim 45,

wherein each of the plurality of pixels further includes a holding portion for holding the photoelectric conversion signal from the photoelectric conversion portion and a transfer switch for transferring the photoelectric conversion signal from the photoelectric conversion portion to the holding portion,

wherein the amplifying element amplifies a signal from the holding portion, and

wherein the driving circuit outputs the first and second photoelectric conversion signals from the amplifying element by changing capacitance of the holding portion.

47. (New) An image pickup apparatus according to Claim 45, further comprising a lens for focusing light onto the plurality of pixels.